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Combustion Behavior of Single Particles of Raw Wood and Pelletized Wood

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What were our motivation and research objectives?

We present a single particle combustion (SPC) study examining the relationship between combustion behavior and particle density.

- There are limited data on the combustion behavior of raw and pelletized wood at suspension-fired conditions.
- Understanding the effect of pelletizing conditions (temperature, pelletizing pressure) on the combustion behavior of pine and beech pellets compared to raw wood in a SPC reactor.
- SPC studies allow to predict the particle combustion behavior in full-scale furnaces.

How was the SPC study performed?

Feedstock

Austrian pine
European beech

Pelletizing conditions

- Particle sizes: 0.25-0.50 mm
- Pressure: 100 and 200 MPa
- Temperature: 75 and 125°C

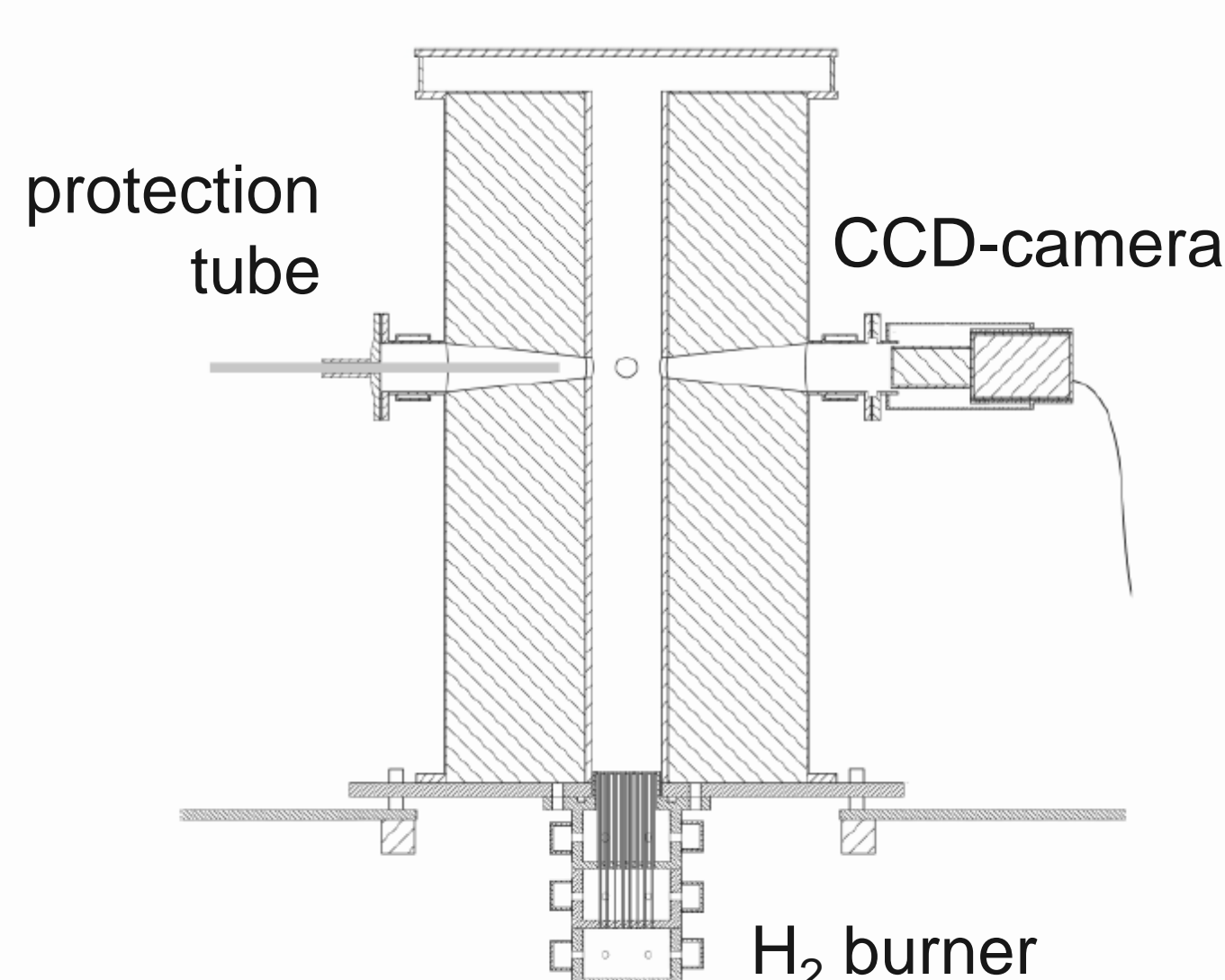
SPC reactor conditions

- Temperature: 1260°C
- Oxygen: 5 % (d.b.)
- Gas velocity: 1.5 m/s

Sample Preparation

- 3 mm pellets using a heatable cubic die and hydraulic press
- 3 mm raw cubes

SPC reactor

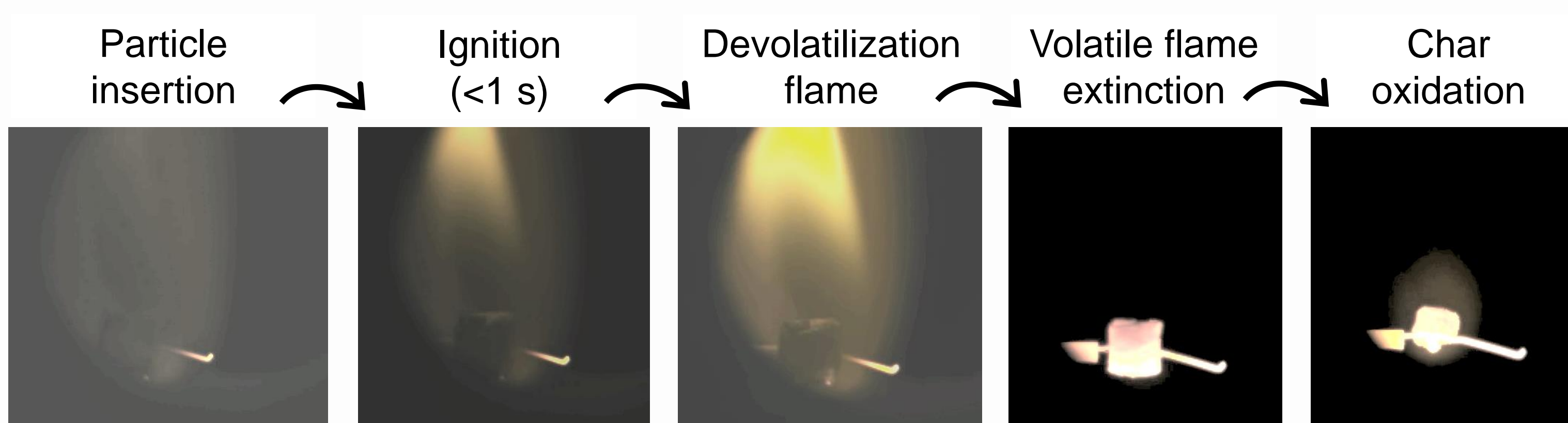


Combustion behavior

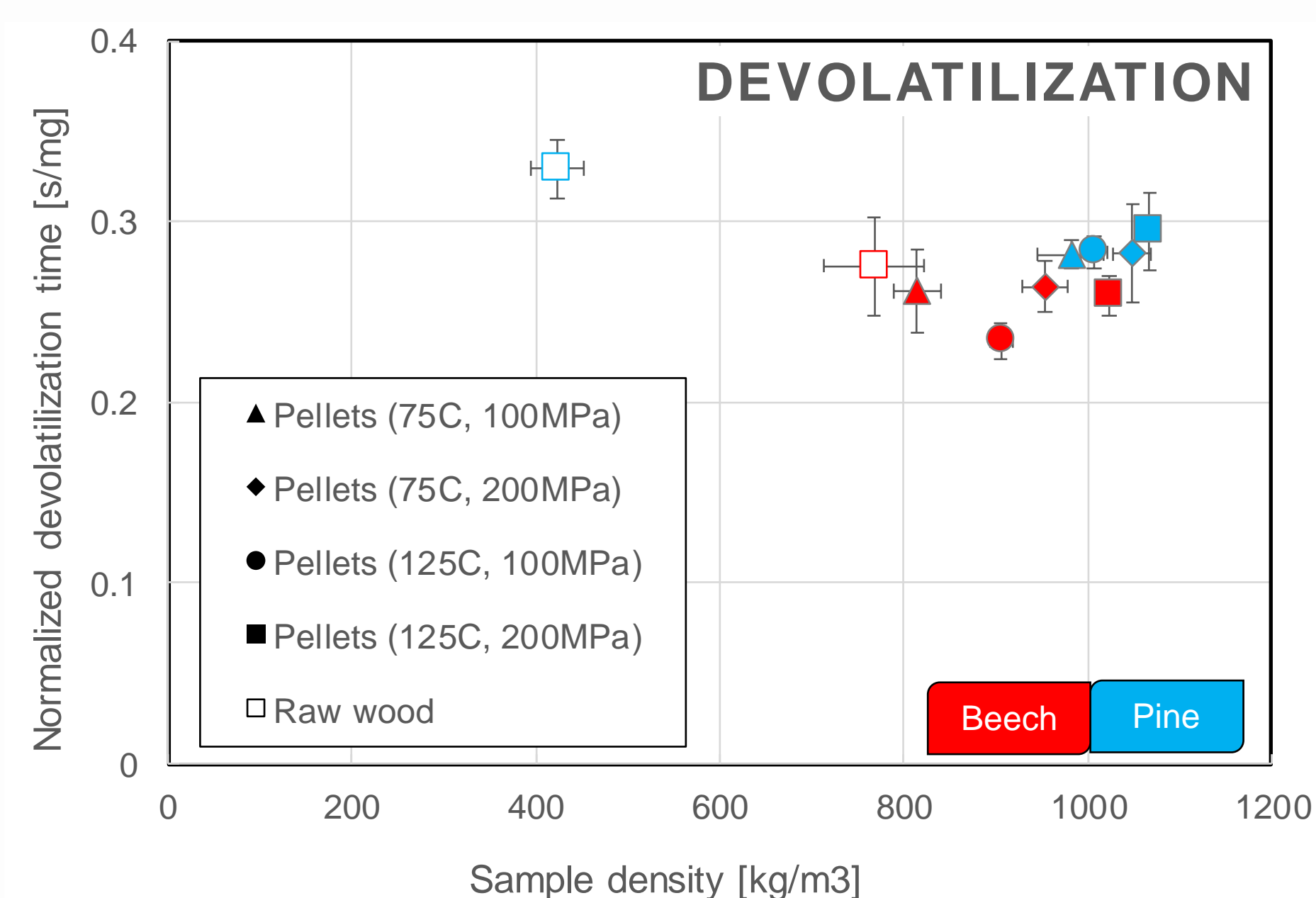
- Devolatilization time
- Char burnout time
- Swelling

Particle conversion process

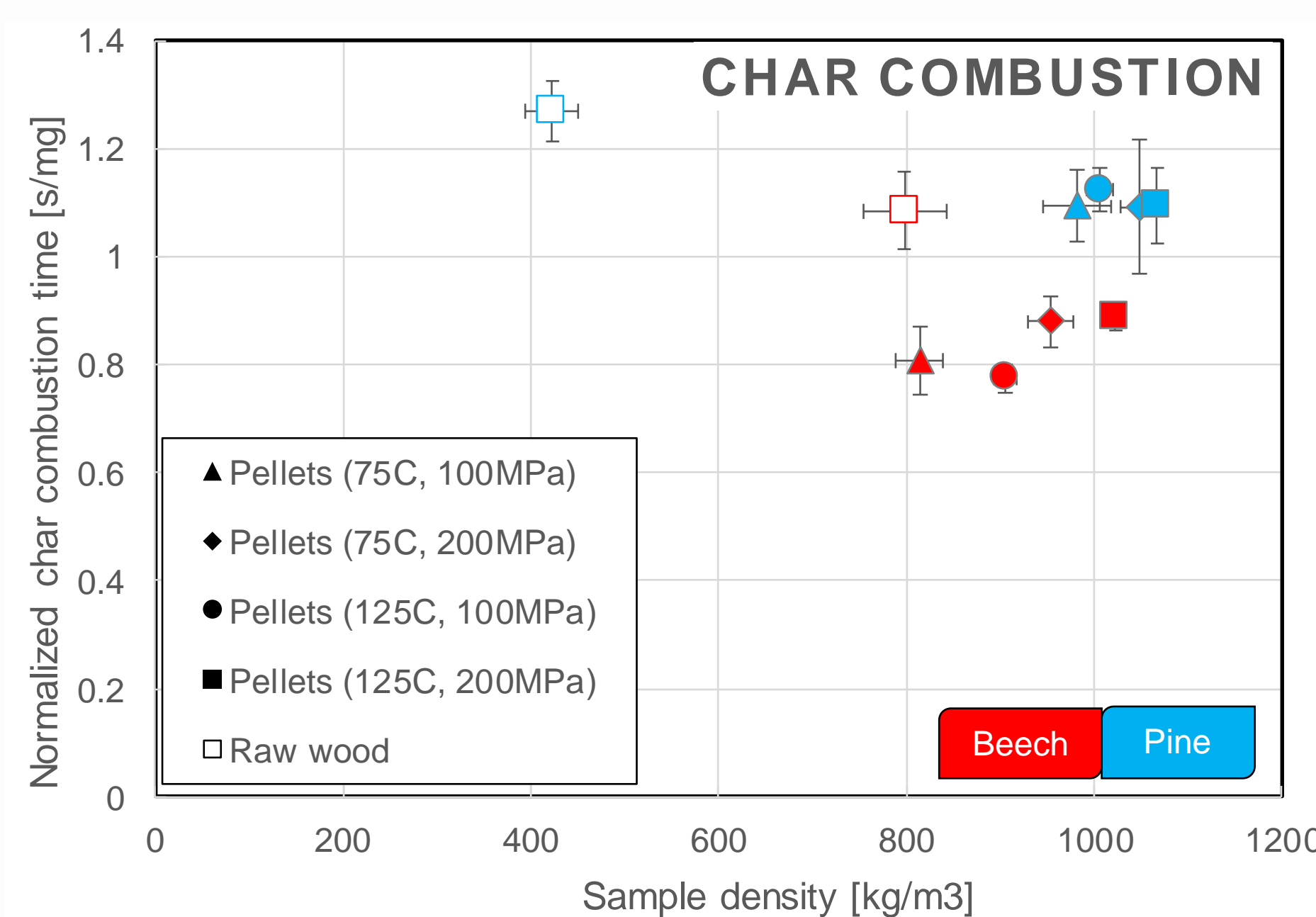
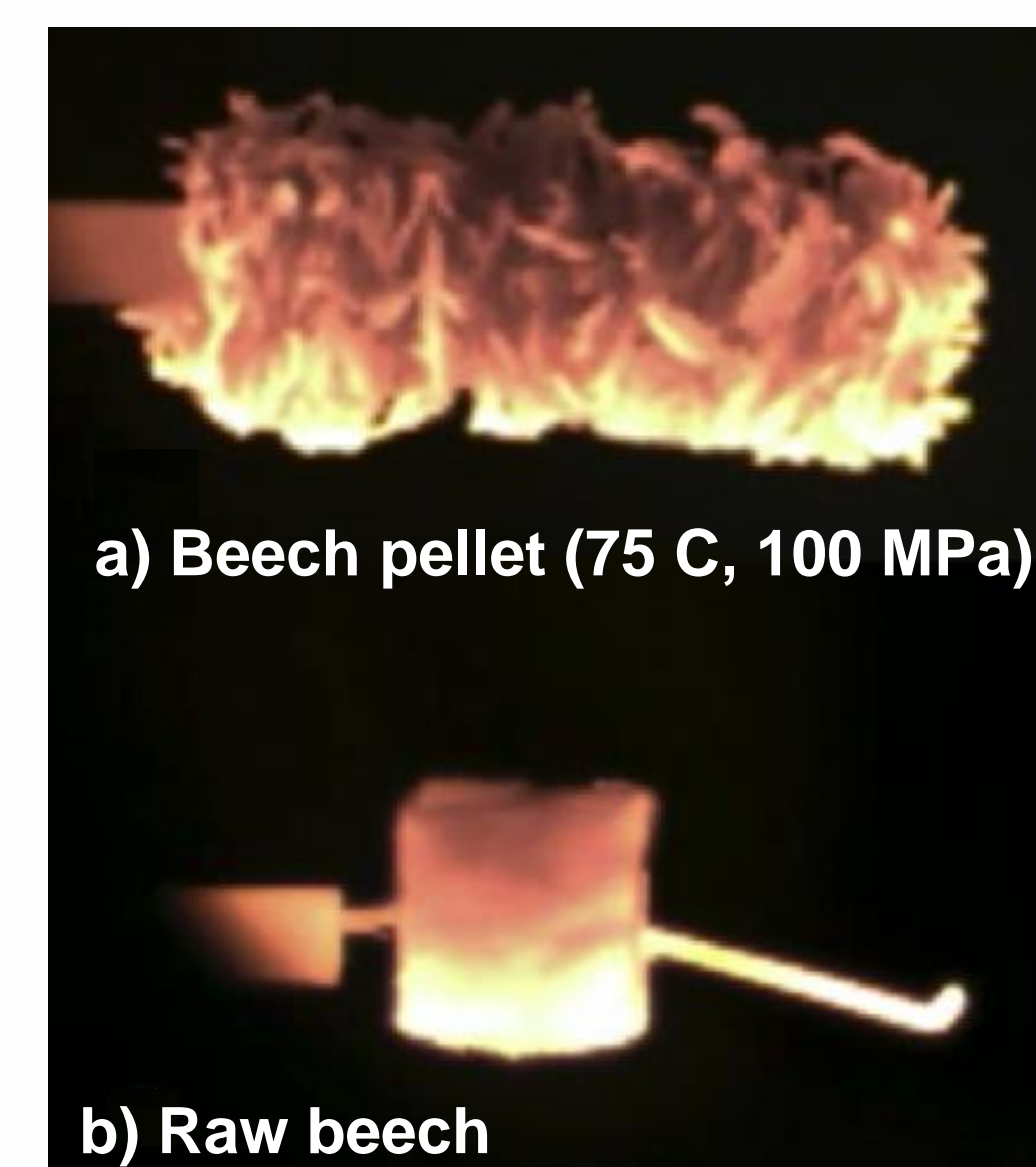
Example: Raw beech cube



Main findings



Swelling during devolatilization



Total conversion
of raw beech vs.
pelletized beech



Watch video

Total conversion
of pelletized pine
vs. pelletized
beech



Watch video

Conclusions

- Pine can be densified more than beech
- SPC study shows that weak inter-particle bonds in pellets
 - Cause swelling during devolatilization, facilitating faster burnout of internal pellet particles compared to single raw wood
 - Affect the conversion process (i.e., faster char burnout of beech pellets due to weaker particle adhesion than pine pellets)